

# Greener Oil Strategies for Sustainability and Profitability

By Constantine Lau

## Executive summary

The global economy wants energy that is clean, green, and affordable. For decades, the oil and gas industry (O&G) has reliably provided energy, especially as transportation fuels. However, this industry is pressured to be greener and safer, emit fewer pollutants, and become more socially responsible.

Many top O&G companies are undertaking new strategies to make their oil “greener”; in addition, investors and financial institutions now use sustainability indexes as a key factor to determine future investment options.

This paper reviews the concepts that the O&G industry can use to increase their sustainability performance with existing strategies and operations to be more profitable in the near and long term.

## Introduction

What determines the *true* value of a company? Is it the annual financial reports, profits, or dividends? In the new millennium, the *true* value of a corporation includes more than economic performance. Social and environmental actions also define the “true” value of a company. For both investors and corporate organizations, the problem is identifying the appropriate metric systems to quantify the activities and performance of any business. Such evaluations should weigh the risks actions in the areas of economic, environmental, and social performance. The risks for financial and consumer-product industries differ vastly from those associated with heavy manufacturing and the energy industry, especially the oil and gas (O&G) sector. With quantitative information, companies can make informed decisions on long-term business strategies while investors and financial institutions can use such knowledge to monetize sustainability achievements.

## Is the O&G Industry vital to the Global Economy?

At present, petroleum meets over 95% of the global transportation demand due to its widespread availability and high-energy density. Combusting fossil fuels by marine, truck, and automobile engines emits greenhouse gases (GHGs), namely carbon dioxide and nitrous oxides—all of which adversely affect the environment. The O&G industry is constantly battling the negative perception of environmental issues, especially climate change. Yet, fossil fuels (crude oil and natural gas) remain deeply intertwined with economic prosperity.

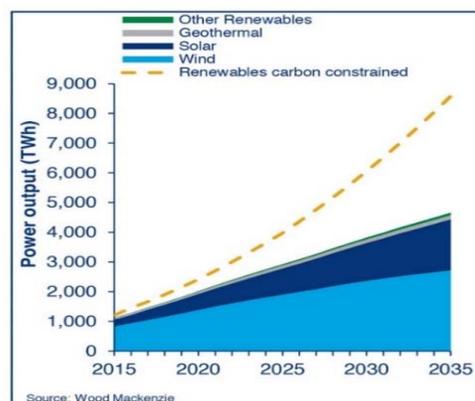
The U.S. Energy Information Administration (EIA) estimates the 2017 global crude oil production and demand at 98.3 million bpd (Mbpd) and 98.46 Mbpd, respectively. By 2018, consumption of crude oil is estimated to exceed 100 Mbpd. What is the value of the O&G industry? The 2015 global oil markets had an estimated value of \$5 trillion USD, approximately 5%-6% of the global GDP.

Finding a balance between fossil fuels, economic development, and sustainability is a paradox for the global economy. The O&G industry continues to create wealth and well-paying jobs that stimulate local, state, and national economies. Sustainability is a long-term goal. Future investment decisions must consider the economic, social, and environmental opportunities, as well as, the political and technical risks.

## Energy Paradox: O&G Industry and Renewables

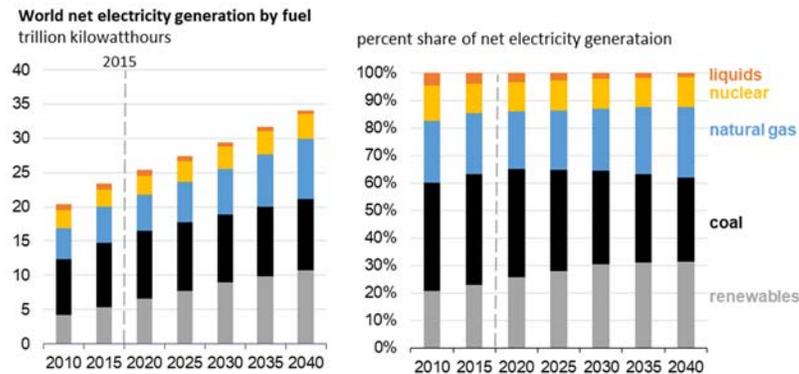
For O&G companies, future growth will be based in a broad portfolio that include renewable energy in various forms. According to a Wood Mackenzie report, wind and solar resources are reshaping the energy sector, especially the electricity market (**Figure 1**). Renewables are potential growth options for many companies, including O&G. At present, renewables provide about 20% of the world’s power generation demand. There has been substantial expansion of wind and solar energy sources.

**Figure 1.** Renewables power market growth, 2015—2035. Source: Wood Mackenzie, “Could renewables be the majors’ next big thing?,” June 2017.



Yet, hydrocarbons (crude oil, coal, and natural gas) still comprise over 80% of energy consumed, according to BP's 2017 "Statistical Review of World Energy." Electricity generation is the largest and fastest growing demand sector. A wide variety of energy types will support future power generation. Natural gas, biomass, and renewables usage for electricity generation is increasing. In contrast, coal's share in power generation is estimated to decline after 2020, as shown in **Figure 2**.

**Figure 2.** World energy consumption by energy source, quadrillion Btu. Source: U.S. EIA, "International Energy Outlook," September 2017.



Fossil fuels still comprise over 90% of the transportation fuel mix. However, the demand for fossil fuels will change under new global fuel-economy requirements for automobiles and light-duty trucks. Fuel economy of new cars will increase from 30 mpg in 2015 to 50 mpg in 2040. Replacement of older models with more fuel-efficient units will not increase gasoline and diesel demand. Likewise, improved hybrid and electric vehicles (EVs) continue to meet growing consumer demand for less-polluting automobiles. New developments in batteries have dramatically lowered ownership costs of EVs, while extending their driving range. At present, more than 2 million EVs are in service globally. Over the next 20 years, full hybrid, electric/fuel cell, and natural gas/LPG vehicles will replace a greater share of the automobile population.

As EVs become more popular, demand for electrical power will increase. **Result:** The electricity-generation portfolio will shift from coal and nuclear systems to natural gas and renewable units. Notably, natural gas-based power plants are more economical to construct, permit, maintain, and operate. More importantly, air emissions from natural-gas power facilities is half that produced by coal-burning utilities.

In addition to changing demand for transportation fuels, O&G companies are under pressure to provide "greener" energy under more sustainable conditions. The O&G industry is considered a major source of GHGs from mobile and stationary sources. The combustion of fossil fuels by mobile sources emits CO<sub>2</sub>. In addition, the production, transmission, and refinement of hydrocarbons generate CO<sub>2</sub> and methane. For example, the refining industry is a major energy consumer and uses thermal processes (crude distillation and coking) to refine higher-value products. These processes are GHG sources.

Accordingly, this industry must expand and broaden the methods used to produce crude oil and natural gas and to process transportation fuels and petrochemicals. Such transitions require vision, investment, and time. The O&G industry will not disappear and become obsolete overnight. More importantly, leading O&G companies will progress as hybrid organizations providing "clean" fossil fuels, low-carbon energy, and renewables to meet all needs.

Statoil has been developing its Hywind technology for offshore applications since 2001. Source: [Statoil](#).



The European Union is very progressive in passing climate-strategy regulations, especially limiting GHG emissions. Working under climate-change rules will require new thinking by O&G companies. For example, 12% of Norway's Gross Domestic Product is based on the O&G industry. In addition, one-third of Norway's exports are O&G products. Statoil, Norway's major O&G company, needed to identify new strategies to meet the national carbon-reduction program and remain a profitable, viable energy organization. For Statoil, harnessing wind power is a major solution for climate strategy. In 2009, the company debuted a demonstration project outside Karmøy, Norway. More projects followed including the pilot offshore wind farm in Aberdeen, Scotland. Statoil is making a giant leap forward in renewable energy with the startup of the world's first floating wind farm.

Changing the energy portfolio is only part of the solution. How hydrocarbons are produced, transported, and refined will determine the success rate for the O&G industry and companies. Using better strategies and proven technologies, O&G companies can cost-effectively achieve sustainability development goals (SDGs). They include environmental, safety, and social achievements. The primary SDGs address: reducing carbon emissions (climate strategy), avoiding accidents (health and safety), and eliminating releases to the environment.

Justifying investments on environmental issues is a tedious task. Finding ROI on environmental/sustainability projects demands different metrics. For example, carbon pricing/trading is in place to encourage medium- to long-term investing to reduce CO<sub>2</sub> emissions. Originally, carbon pricing was used as a method to substitute natural gas over coal in power generation and reduce CO<sub>2</sub> emissions from stationary sources. Determining a fair price (proper value) for carbon is a problem. At present, carbon prices range between \$40 to \$60/ton of CO<sub>2</sub>. Now, carbon pricing is a tool to stimulate clean technology and innovation and fuel economic growth for low-carbon energy resources. New technologies such as carbon capture and storage (CCS) are in early development and considered promising methods to reduce global CO<sub>2</sub> emissions. Carbon pricing is an opportunity to leverage R&D costs for CCS innovations. Approximately 40 countries have carbon-pricing programs in place. However, the trading of carbon credits remains difficult.

Looking ahead, the O&G industry will include sustainability programs into their business plans. Such efforts offer: greater business values, strengthen relations with employees and investors, improved operations, and enhanced trust with the public.

## Measuring Sustainability



O&G companies are at various reorganization stages with evolving social and environmental commitments. Sustainability is a very broad benchmark; it includes performance in safety, environment, and social issues. Several programs can evaluate sustainability performance. For example, the Dow Jones Sustainability Index (DJSI) is a recognized indexing program that has compiled sustainability ratings for many years. RobecoSAM, a specialist group focused exclusively on sustaining investments, conducts the Corporate Sustainability Assessment (CSA) used by the DJSI. This group has over 17 years of nonfinancial data from thousands of companies. The CSA is the first global index and provides sustainability ratings in three areas: economics, environmental, and social performance.

### Methodology

The CSA is an involved process. For the 2016 CSA, RobecoSAM, invited 3,400 companies from developed and developing countries who represented a broad spectrum of industries from financial to heavy manufacturing. Invited companies received an industry-specific questionnaire with 100 financially relevant questions, as well as an interview. Along with company inputs, RobecoSAM reviewed public-domain information, including company sustainability reports, news release, and other media sources.

As a complex, industry-specific metric system, the CSA evaluates and rates participant companies. For example, energy management is vastly different for O&G companies as compared to banks and other financial institutions. However, *all* companies are evaluated and rated on a core set of CSA criteria. Only the top 10% of the companies from the annual survey are DJSI winners.

**Table 1** summarizes the general evaluation criteria. In all of the possible categories, surveyed companies showed the highest scores in codes of business conduct, corporate governance, and environmental policy and management. Areas still needing improvement are operational eco-efficiency, human capital development, and materiality (a new item for the 2016 survey.) The most improved CSA areas were corporate citizenship and philanthropy. Companies are increasing support to their corporate citizenship activities while aligning these efforts with business drivers.

**Table 1. General evaluation criteria for DJSI**

Economics	Environmental	Social
Corporate governance	Environmental reporting	Human-capital development
Risk and crisis management	Industry specific	Talent attraction and retention
Code of conduct/ anti-bribery		Labor practices indicators
Industry specific		Corporate citizenship/ philanthropy
		Social reporting
		Industry specific

Source: RobecoSAM AG, "The Sustainability Yearbook 2017," 2<sup>nd</sup> Ed., January 2017.

**Table 2** highlights the industry-specific criteria for the O&G industry by business divisions: upstream, midstream, and downstream (refining and marketing.) For integrated O&G companies, the sustainability metrics differ. Yet, common performance areas are present for the different O&G divisions. They include codes of business conduct, climate strategy, operational eco-efficiency, and occupational health and safety performances. From the invited 3,400 organizations, 315 were named 2016 DJSI winners; 10% of those winners are O&G companies.

**Table 2. Evaluation criteria for O&G companies.**

O&G Upstream	O&G Storage and Transportation	O&G Refining and marketing
<b>Economic dimension</b>		
Codes of business conduct	Codes of business conduct	Codes of business conduct
Exploration and production	Corporate governance	Risk & crisis management
Gas Portfolio	Risk & Crisis management	Supply chain management
<b>Environment dimension</b>		
Climate strategy	Climate strategy	Climate strategy
Operational eco-efficiency	Operational eco-efficiency	Operational eco-efficiency
Water-related risks	Environmental policy & management	Water-related risks
<b>Social dimension</b>		
Occupational health and safety	Occupational health and safety	Occupational health and safety
Social impacts on communities	Social impacts on communities	Social impacts on communities

Source: RobecoSAM AG, "The Sustainability Yearbook 2017," 2<sup>nd</sup> Ed., January

**Table 3** lists the 2016 DJSI top performing O&G companies. Integrated upstream companies showed stronger sustainability performance. Over 74 upstream O&G

companies were invited to the 2016 CSA; 65 companies (88%) responded. Of the 28 downstream companies invited, only 20 companies (71%) participated.

**Table 3. DJSI 2016 top performing O&G companies**

GOLD	SILVER	BRONZE & BELOW
Enbridge Inc. (Canada)	Galp Energia (Spain)	AltaGas Ltd. (Canada)
PTT Exploration & Production (Thailand)	Total Sa (France)	Eni S.p.A. (Italy)
SBM Offshore (Netherlands)	Woodside Petroleum (Australia)	Inpex (Japan)
Thai Oil (Thailand)		IRPC (Thailand)
TransCanada (Canada)		Koninklijke (Netherlands)
		MOL (Hungary)
		Neste Oy (Finland)
		Organización Terpel S.A. (Columbia)
		Repsol (Spain)
		Royal Dutch Shell (Netherlands)
		S-Oil (S. Korea)
		Santos (Australia)

Source: RobecoSAM AG, "The Sustainability Yearbook 2017," 2<sup>nd</sup> Ed., January 2017.

## Making Progress

Common areas for the upstream, midstream, and downstream companies are: business conduct (ethics), climate (change) strategies, and occupational health and safety practices. For O&G companies, safety performance is the number one priority. This industry handles flammable fluids and finished products. The high volume of flammable materials managed adds more risk to daily operations. The exploration/production, transmission/distribution, and refinement of materials handled by the O&G industry require complicated processing equipment and operations. O&G companies are under tremendous pressure to reduce risks from all processing operations while protecting workers and the environment.

Next-generation smart field devices and advanced computer/control (monitoring) systems greatly automate processing operations. Risks from accidents or releases can be minimized by adopting proven procedures and use of innovative technologies and strategies. Safe operations and protocols are important; failures in such systems affect human life, production (economic) assets, and the environment. In particular, recent catastrophic industrial incidents have damaged the O&G industry's image and fostered growing support for renewable energy.

From **Table 2**, occupational health and safety programs greatly influence sustainability performance. Likewise, reducing dependence on crude oil is a substantial part of climate-strategy programs. Consequently, sustainable O&G companies are diversifying their operations to include low-carbon energy resources and equally support programs to improve process and worker safety. DJSI companies are using nontraditional solutions to restructure themselves for the new low-carbon energy market and expand safety performance:

### Total SA—Silver level DJSI company

Total SA (Total) is on track to becoming a low-carbon organization. This international company is ranked No. 4 in the global O&G industry and is a leader in the European Union biofuels market. As part of its sustainability goals, Total is ambitious and plans to have low-carbon businesses comprise 20% of its portfolio by 2035.

*"We owe it to our stakeholders to provide a safe work environment, but we owe it first to ourselves and our employees, as well as to those of our partner companies. Our ability to operate safely and reliably all over the world is the foundation of our operational excellence and business performance."*

Patrick Pouyanné, Chairman and CEO Total SA

Low-carbon businesses will include midstream and downstream gas, renewable energies and energy storage, energy efficiency, clean fuels, and carbon capture and storage (CCS) technologies.

Total is branding itself as a responsible provider of affordable, reliable clean energy. The company is taking great actions into electricity generation. Solar and wind projects are viable renewable solutions to low-carbon-energy sources. In 2011, Total acquired a major stake in SunPower, a world leader in photovoltaic solar energy technology, and formed Total Solar. To meet the 20% renewables target, the company reorganized and created a new segment to spearhead this mission. With SunPower and Total Solar, Total is active across the entire photovoltaic solar value chain: manufacturing photovoltaic cells, designing utility-scale power plants, and installing solar home systems.



Total is converting the La Méde refinery to a biorefinery and replacing crude oil with vegetable oil. Startup of the biorefinery is planned for 2018. Source: [Total SA](#).

In addition, the company is strengthening its biofuel operations. Total has been producing biofuels for over 20 years. To be more in line with the low-carbon mission statement, the company is transforming the La Méde refinery into a biorefinery. Replacing crude oil with new and used vegetable oil as feedstock, this refinery will produce 25,000 tons/yr. of bio-naphtha and up to 60,000 tons/yr. of aviation fuel. Startup is planned for 2018. In addition, the La Méde refinery will be powered by an 8-MW solar farm using SunPower technology.

For Total, safety is the core value. The company's safety program measures injury rate, lost-time injury, and lost-production incidents. In addition, it evaluates the severity of the accident—the number of days loss per lost-time injury. Total works diligently to be recognized as a benchmark for safety in the O&G industry. As a global energy company, Total needs the trust and support of local communities and governments. The company has taken steps to ensure that safety is an integral part of processing operations. Total achieved a 57% decrease in the total recordable injury rate over the past five years. Training is central to Total's sustainability program.

### Royal Dutch Shell plc—Bronze level DJSI company

Ranked No. 2 in major international O&G companies and a 2016 Bronze DJSI winner, Royal Dutch Shell plc (Shell) is equally committed to cleaner energy initiatives. Commitment to safety, the environment, and communities plays a crucial role in how Shell plans, designs, and operates projects and facilities.

Shell is working continuously to improve safety in the workplace by means of research, standards development, and implementation of an array of programs involving training, monitoring and measuring, data gathering, information transfer, and assessment. Workplace safety covers a large and varied set of procedures, conditions, and environments. Shell continues to improve its safety performance. Over the past decade, Shell has reduced total recordable injuries and process safety incidents from 1.9 to 1 per million working hours (employees and contractors). Likewise,

Shell's efforts focus on designing and building facilities that include a lifecycle program to ensure safe operation of equipment and supportive maintenance/reliability programs.

To develop natural gas fields off the northwest coast of Australia, Shell commissioned a floating LNG (FLNG) vessel, the Prelude, a \$12.6-billion project. The 488-m vessel can extract and liquefying natural gas at sea using Shell's LNG technology; it arrived at local waters of Australia in July 2017.  
Source: [Shell](#).



Shell is integrating low-carbon-energy possibilities into its businesses. In 2016, Shell created New Energies to explore investment for biofuels, hydrogen, and renewable energy. This business also investigates new opportunities that combine wind and solar power with natural gas. As part of its commitment to climate strategy, Shell is divesting its interest in oil sands and expanding its portfolio with lower-carbon energy sources, mainly natural gas. To expand natural gas resources, Shell acquired BG Group Ltd. (BG) in 2015. The \$54-billion investment was a key move to increase Shell's cleaner-burning fuels capability. BG held substantial LNG production capacity and other assets in Australia, East Africa, Brazil, Egypt, and Tanzania. With BG, Shell is a leader in the global LNG market.

Besides natural gas, Shell continues R&D efforts on next-generation biofuels. For example, Raizen, a joint venture (Shell interest 50%) in Brazil produces low-carbon biofuels from sugar cane. Under the agreement, Shell has exclusive development and licensing rights for new biofuel technology. The patented process converts a wide range of waste oils, greases, and sustainable vegetable oils into lower carbon drop-ins for diesel, jet fuel, and gasoline.

The DJSI recognition is awarded to companies that exemplify outstanding performance, as shown in [Table 1](#).

### Schneider Electric- Gold level DJSI company

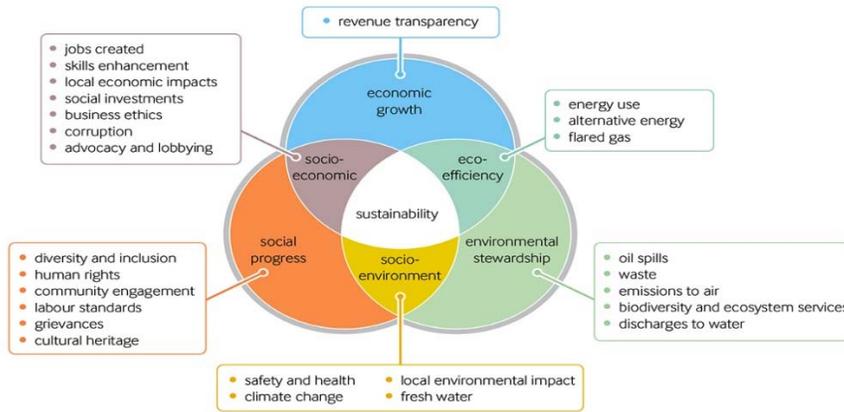
A manufacturer/supplier of electrical distribution, process automation, and industrial software solutions that serves the O&G industry, Schneider Electric, has won many top awards for being a green and ethical company. This organization has demonstrated outstanding performance and has been a DJSI Gold winner for four consecutive years (2013-2016). The company is ranked No. 24 out the 50 companies changing the world, as published in *Fortune* magazine. Schneider Electric is part of the "Climate A" list for the sixth consecutive year for Climate Leader. In addition, the company is ranked among the world's most ethical companies by Ethisphere.

## Sustainability is a Process

There are different ways to becoming a sustainable company. Yet, all companies can apply several common methods. The International Petroleum Industry Environmental Conservation Association (IPIECA) along with the American Petroleum Institute (API), and the International Association of Oil and Gas Producers (IAOGP) publish guidelines on voluntary sustainability reporting. As shown in [Figure 3](#), O&G companies must consider three evaluation areas when developing and re-evaluating sustainability programs. **Note:** These programs use similar key performance indicators (KPIs) as the DJSI: Environmental, Economic, and Social. According to IPIECA, companies must identify key issues and assign priority metrics. Such programs are

not one-time action plans; assessing past performance and committing resources on improvement areas are also part of the journey to sustainability.

**Figure 3.** Sustainability issues for O&G companies. Source: IPIECA, “Oil and gas industry guidance on voluntary sustainability reporting,” [www.ipieca.com](http://www.ipieca.com).

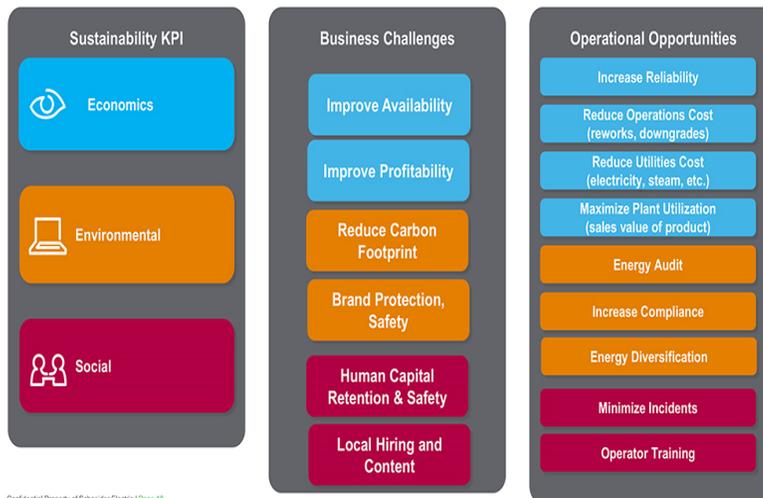


Sustainability can be profitable. There are many pathways to increase sustainability performance and opportunities to adjust plans as the global economic environment changes. In the energy industry, change is a law. Profitable companies are those that quickly and efficiently adapt to constantly evolving conditions.

**Figure 4** summarizes sustainability KPIs and links to business and operational challenges. For economic performance KPIs, business challenges focus on improving unit/plant availability and profitability, such as reducing capital and operating expenditures (CAPEX and OPEX). The operational success opportunities are increasing reliability performance, reducing operating costs, optimizing energy (steam, electricity, etc.) management, improving conservation efforts, and maximizing plant utilization rates.

## Is Sustainability Profitable?

**Figure 4.** Sustainability KPIs and links to business and operational challenges.



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For environmental performance, business challenges concentrate on climate strategy (reduced carbon footprint) and brand protection/safety. Incidents and releases to the environment, especially by the O&G industry, can become major catastrophic events. Even minor cases can attract public and regulatory scrutiny. In some instances, the damage to the brand can become a financial meltdown. Operation efforts to meet sustainability goals will use energy audits to establish baselines and areas of improvement, increased compliance to federal, state, and local regulations,

and energy diversification (low-carbon resources). To reduce their carbon footprint, O&G companies are diversifying investments into alternative energy.

For social KPIs, the business challenges are more diverse and focus on the treatment of employees and the public. Better human capital retention and safety programs are essential to positive sustainability ratings. More emphasis on local hiring (training) and vendors are sustainability criteria (**Figure 4**). For example, during the construction of an LNG facility in Nigeria, Schneider Electric assisted the local government in building infrastructure. The company created training programs, hired resident talent, and used local vendors throughout the project. At the operational level, the priorities will be better safety/operator training to minimize incidents by employees and contractors. (**Figure 3**). Attaining high marks in sustainability KPIs will involve the successful merging of business and operational challenges.

Sustainability is a wide performance indicator and is comprised of many different parts. To be successful, companies should apply long-term planning that includes performance criteria in Economics, Environment, and Social. For the O&G industry, worker and process safety is the highest priority. Better safety programs are central to any company's mission statement. Industrial accidents damage the reputation for any organization; best-of-class companies are vulnerable to media meltdown from an accident or spills. Better training programs and industry standards have greatly reduced injury rates for the O&G industry. In addition, advancements in automation (hardware and software) solutions now provide more information on the condition of the process/unit, equipment, and vessels. With such capabilities and knowledge, companies can operate processing facilities in a safer environment.

### Avoid incidents with safety systems

Safety is a continuous program. Plant/unit conditions change with new equipment or processing conditions. Training and maintenance of processing equipment is ongoing. For the energy industry, the facility's safety system is the last defense against a catastrophic accident. The emergency shutdown (ESD) systems and fire and gas safety systems must perform near 100% with no failures.

For EDS and fire and gas monitoring systems, a holistic integrated safety pyramid will include trusted technologies, informed operations, and lifecycle management practices. Safety pyramid systems should seamlessly integrate with advanced distributed control system (DCS) technologies via industry standards open protocols—OPC and Modbus. It should support modern smart-field devices and protocols, including HART™. Intelligent integration reduces risks and improves equipment availability. In addition, safety systems use redundancy to ensure false signals do not compromise the operation of shutdown/emergency relief systems. To be more sustainable, execution of process and worker safety programs and training must be supported by reliable instrumentation, monitoring, and control systems. The *Glas Dowlr Kitan* project illustrates the possibilities to improve operations and safety.



## Technologies to assist in Sustainability Programs

The *Glas Dowlr Kitan* needed substantial retrofits to remain operational. Working with Schneider Electric, this FPSO was successfully upgraded. See the full [case history](#).

*According to Ernest Hofstee of Bluewater, “In my experience, project delays often happen when work is handed over from one party to another, which causes delays due to knowledge being passed around... This didn’t happen on the Glas Dowl project. We maintained a ‘one-team’ approach all the way through... All the work was carried out by the same people, which minimized delays and disruptions.”*

## Case History: Modernization of a FPSO vessel

The *Glas Dowl Kitan* (*Glas Dowl*) is a floating, production, storage, and offloading (FPSO) vessel owned and operated by Bluewater Energy Service B.V. (Bluewater). FPSO vessels safely convey produced hydrocarbons (liquids and gases) from the wellheads to a production vessel and from the floating storage platforms to export tankers. Taking an FPSO vessel offline for repairs and upgrades is a huge economic risk. After 13 years of service, the *Glas Dowl* needed to replace the existing DCS and install a new integrated control and safety system (ICSS).

**“Change-the-game” approach.** Modernization of the *Glas Dowl* would be a complex project, involving full replacement of the ICSS and migration of the existing ICS. Bluewater needed a partner to retrofit the *Glas Dowl*. Using the changing-the-game approach, Bluewater partnered with Schneider Electric in designing and installing a full-replacement solution with a proven low-total cost of ownership and high system availability. A project-based approach was used with engineering teams located in The Netherlands, Slovakia, Germany, and Singapore.

The new fully integrated solution involved a number of products: EcoStruxure Foxboro® DCS, EcoStruxure Trident Safety System™, EcoStruxure Tricon Safety System™, instrumentation (including level, pressure, flow, and temperature sensors), and EcoStruxure Wonderware historian. In addition, Schneider Electric replaced I/Os and marshalling cabinets, PLCs, control cabinets, control processors, and redundant control network infrastructure.

## 3D-virtual reality techniques enhance operator training

Operator safety and training programs are evaluation metrics on the DJSI questionnaire. Improved understanding of the process unit and plant operations yields economic, environmental, and social benefits—both tangible and intangible. High-fidelity training simulators manage real-plant models that replicate conditions for offshore platforms and refineries. A key benefit from 3D-virtual reality training is that O&G companies can safely train control room and field operators.

High-fidelity training simulators replicate the exact equipment or control screen for the operator on a separate computer system. New operators can review and conduct equipment/plant procedures without jeopardizing worker and plant safety. In addition, new operators can learn best practices for less frequent operations, such as shutdown and startup in a safe environment. The airline industry uses flight simulators to train pilots and reinforce proper actions during a flight emergency. The O&G industry is capitalizing on 3D-virtual reality training to reduce plant maintenance and unscheduled downtime. The Kuwait Oil Company used smart training to maintain efficient refinery operations while ensuring worker safety and competence.

## Case history: Kuwait Oil Company

The Kuwait Oil Company (KOC) oversees the country’s upstream O&G industry, which is the sixth largest oil reserve in the world. KOC’s mission is to explore and develop Kuwait’s hydrocarbon resources in an economical and environmentally safe manner. For many years, KOC used training simulators. However, new operator training requirements needed a more in-depth approach. The solution was Schneider Electric’s EYESIM™, a high-fidelity, 3D-process simulation. The Operator Training Simulators enable new and existing operators to train and refresh skills on an exact replica of the facility. More importantly, operators can effectively hone skills needed during emergency/abnormal situations that rarely occur.

*“In managing the talent within an organization, it’s very important to focus on smart tools to develop the skills of workers in the required competencies that result in overall success of the company. The immersive virtual reality training from EYESIM™ helps give KOC personnel the skills needed to confidently and skillfully run our production processes.”—Ali Al-Farhoud, with KOC S&EK, the company’s operations technical personal development service group.*

**EYESIM™** is high-fidelity training simulator that is an exact replica of the plant. In a safe environment, field operators can practice procedures and workflow, especially startup and shutdown situations.



In addition, the high-fidelity training simulator enables capturing knowledge and best practices of experienced operators, thus increasing worker efficiency and reducing costly errors. Previously, KOC trained operators directly on the plant floor, which made it difficult to ensure efficient production. The new system is a comprehensive program and grows with the needs of the company. Immersive reality training enhances safety, resulting in fewer accidents and reduced shutdown events.

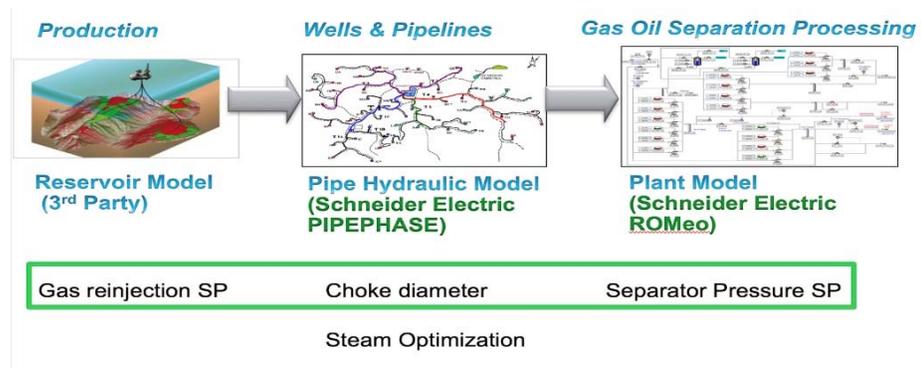
### Dynamic models optimize energy efficiency

O&G companies must execute many performance metrics to be named a sustainable organization. From **Figure 3**, energy use and alternative energy comprise eco-efficiency on the sustainability list. Controlling energy costs and maximizing operations are economics criteria for Sustainability KPIs. The O&G industry pursues projects that optimize energy management and lower operating costs. Dynamic simulation models have proven very valuable in optimizing energy balances. Managing the complex equations and fluid properties of produced hydrocarbon fluids requires advanced models and data sets. For a heavy oil project, proven simulation/optimization tools were vital in optimizing energy management and reducing OPEX.

### Case History: Heavy Oil Optimization Project

A South American O&G company was developing an 8-°API heavy oil field. Considerable steam consumption is used in producing heavy oil. Consequently, energy management across the operation greatly influences profitability. The O&G company selected robust simulation products to improve energy efficiency with a focus on steam consumption. Schneider Electric's PIPEPHASE model monitored the production pipeline network. This black-oil model fully characterizes oil-field production fluids, including oil, condensate, and water. The PRO/II automated model monitored the gas condensate fields with the sophisticated process plant. In this project, both models were integrated to simulate the entire field asset—wells, surface network, facilities, and export pipeline. In addition, the ROMEo model performed data reconciliation on the fiscal measurements.

Using the **SimSci models**, a South American O&G company optimized steam consumption across the entire value chain, thus greatly improving energy management.



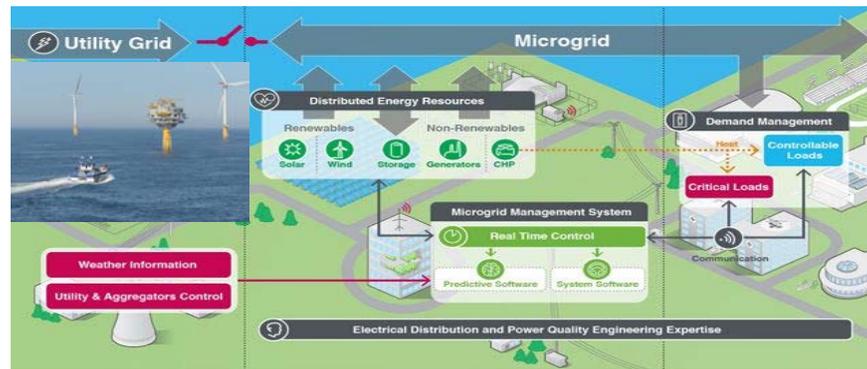
The integrated models investigated steam usage in the reservoir (gas reinjection SP), wells and pipelines (choke diameter), and the gas-oil separation processing. By using a collective review of steam consumption, improved energy management and efficiencies were achievable via a system-wide optimization program.

### Smart microgrids optimize energy resources

A portion of future energy demand is driven by offshore platforms. To optimize energy requirements for offshore facilities, new smart-grid solutions and energy resources are needed. In some cases, solar and wind resources can provide ways to eliminate the need for turbines and generators on platforms. Smart microgrids can be integrated to optimize renewable energy for offshore installations. Solar or wind resources close to offshore or on platforms can be tied to an onshore grid.

At present, industrial electrical power is not storable; it must be generated and used in real time. Unfortunately, there is always an imbalance between demand and supply. The typical power source on platform is a gas or steam turbine. For emergencies, a diesel-powered generator is used. Looking ahead, the O&G industry will take advantage of wind and solar power next to offshore or ties to a grid. In such cases, a smart microgrid can optimize loading for power systems.

Future energy resources will utilize offshore solar and wind sources. Smart microgrids will play a vital role in connecting new energy resources to onshore power grids.



### Reduce CAPEX by rethinking power systems and EHouse design

A major initiative for the O&G sector is reducing CAPEX. Due to the prolonged low oil-price environment, ongoing efforts to lower capital spending are crucial. Key to new and existing production projects is managing costs via modular construction and smaller unit designs. To reduce CAPEX, upstream O&G operators must identify equipment that is not necessary in terms of footprint and functionality without compromising safety. Next, all efforts must ensure that the construction/revamp schedule is met without delays in “first oil” production. Any delay means exponential increases in project costs and lost profits.

By engaging early and considering an optimized power architecture, O&G companies can determine the E-House footprint and power system that will meet their needs safely and cost-effectively. Energy management is a sustainability KPI and operating cost. Lowering energy consumption is a sustainability goal. O&G operations are large energy (electricity and steam) consumers. Reducing power consumption with more-efficient systems through E-House assessment enables costs savings via CAPEX and OPEX and, likewise, increases the sustainability performance of the unit.

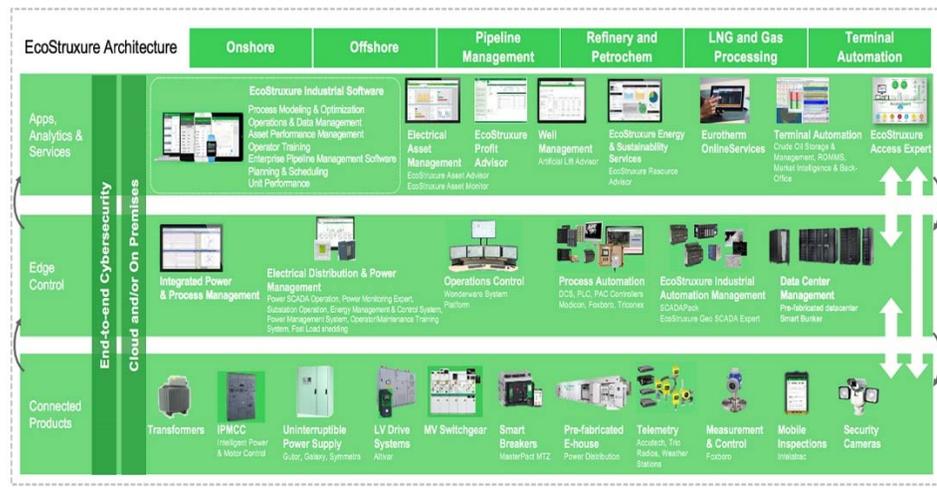
In any project, costs and schedules are success-determining factors. Finding methods to enable flexible and lean execution of automation/control designs influences

capital costs and project schedules. Newer design methods, such as Schneider Electric's Flexible Lean Execution (FLEX) can assist design and automation engineers. The foundation of FLEX is the early sharing of process data to engineers, thus minimizing errors. Using universal IO technology can remove automation out of the project's critical path. Working in the Cloud, engineers have access to special configuration and documentation software. Likewise, project engineers work in a more collaborative environment. Templates use built-in safety and security rules, thus eliminating design errors. In addition, knowledge and best practices are used throughout the design process, ensuring consistency and standardization. In some cases, minimizing design errors can reduce project CAPEX by 30%.

## IloT offers enterprise wide optimization opportunities

In today's competitive market, leveraging market and business knowledge separates leading companies from the rest of the pack. Cost reductions in smart technology, especially sensors, field devices, and wireless technologies, foster widespread adoption of digital information and reporting. Wireless communication networks eliminate expensive cabling costs and lower installation expenses. Through the IloT, companies can take advantage of energy management, automation, and safety modeling/monitoring software and services. Remote/centralized expert teams can monitor and analyze process information, thus enabling real-time decisions through cloud-based solutions.

**EcoStruxure** for Oil and Gas  
Innovation At Every Level



With [EcoStruxure Architecture](#), O&G companies and industry partners can augment operations reaching new levels of operational efficiency, sustainability, asset performance, actionable intelligence, and people productivity.

Digitalization has changed how companies exchange and monitor information. The IloT brings new connectivity opportunities and the risk of cyber-attacks. The key to IloT is the platform/architecture that links field devices and edge-of-control systems to apps and analytic services. Such interoperability and open information can deliver value across the entire enterprise supply chain. Security and reliability are the core with connected products and edge controls. They serve as the foundation for smarter operation and optimized production.

In addition, advanced digital/automation platforms support enhanced safety programs, improve energy efficiency, and optimize equipment reliability and availability. Innovative new apps, analytics, and connected (smart) devices enable companies to mine data across the enterprise, find knowledge to drive profitability, and achieve greater sustainability performance. With such tools, real-time solutions are possible. In short, information is open and interoperable. Schneider Electric's EcoStruxure is a

purpose-designed digital enterprise platform that will minimize risk of interoperability and security while implementing IIOT cloud-based solutions:

- Process and operations information is mobile and needs security and interoperability across the supply chain. In the Cloud, companies have access to the latest version of software and models in a secure environment. Using such tools, O&G companies can remotely monitor unit/equipment performance and increase safe operations across the business unit and enterprise. Some of the major benefits are reduced process upsets and flaring, which directly affect sustainability performance. For example, new upstream regulations limit flaring. Managing produced natural gas is necessary to minimize flaring events. Likewise, improved process control and monitoring enables downstream facilities to maintain steady operations. Better equipment monitoring and maintenance prevents failures and unscheduled downtime. With an optimize platform, process upsets, equipment failure, and unscheduled downtime tremendously reduce emissions (air and product) and support better environmental and sustainability performance.
- Asset management is a proven example of IIOT application. In this case, IIOT brings the remote asset data to the experts. In extreme cases like an offshore platform or a remote plant, the expert teams are not onsite. However, they can review process/site data and provide advice in real-time. Efficiency improvements can be achieved through reduced unscheduled downtime and lowered unnecessary traveling costs. Artificial intelligence (AI) is the latest innovation. In particular, experts are investigating how AI can assist in automatically providing diagnostics, generating solutions, and advising for remote assets and operation. Such O&G plant assets include compressors, pumps, controllers, valves, instruments, transformers, drives, etc.
- Cloud-based technology enables thin-client applications without having hardware onsite and are just software enabled. Consider a process optimization and simulation project using a cloud-based solution. Now, the operating company is not burdened in maintaining onsite hardware and software; both are expensive and time consuming. Cloud-based software is updated automatically. Advance control or process optimization experts can remotely monitor performance and energy efficiency. Better operations yields major benefits such as reduced process upsets and flaring, which negatively affect sustainability and environmental performance.

*The next industrial revolution, Industry 4.0, the Industrial Internet of Things (IIoT) – whatever you want to call it, is one of the primary megatrends impacting our market today. . . We are approaching the advent of the Industrial Internet of Things as an “evolution,” rather than a “revolution.” We will draw on our long history of innovation in open architectures and Ethernet-based technologies to guide you through this transformation.*

Greg Conary, Schneider Electric's Senior Vice Presi-

### Sustainability and safety maintained during a natural disaster

Some events are beyond the operating companies' control, such as extreme weather and hurricanes. Media coverage on Hurricane Harvey clearly described the widespread impact that this weather phenomenon had on the U.S. Gulf Coast. Hurricane Harvey was a slow moving storm unleashing over one trillion gallons of water; in some areas, 42 inches of rain fell over a two-day period. The Gulf Coast is home to one-fifth of the domestic U.S. refining capacity along with major pipelines to the East Coast and the end point for pipelines sending crude oil from the Permian basin and the Gulf of Mexico.

In prestorm preparation for Hurricane Harvey, the O&G industry proactively began shutdown of refineries and onshore and offshore production facilities. About 18% of the offshore oil production and 19% of offshore natural gas production were shut-in as part of safety and environmental actions. Over one-third of the U.S. refining capacity was affected directly by the storm or by interrupted crude supplies. During this storm, fifteen refineries (39.9% of total Gulf Coast PADD 3 capacity) were shutdown or operating at reduced rates.

After the storm passed and the floodwaters receded, the O&G industry quickly began the restart process for production units, refineries, and pipelines. Safety and environmental requirements are the foundation in resuming normal operations. Training is critical during startup. In addition, process monitoring by site and remote staff enabled the safe return to full operations. Especially after a tremendous weather event such as Hurricane Harvey, startup of a numerous production units or refineries is an abnormal event.

During startup, O&G facilities are not at normal operations. Confidence in operator training and plant control and field monitor/control devices is critical in restarting refinery units, oil platforms, and pipelines. Safe and efficient restarts minimize flaring and air releases, thus protecting the environment. Access to remote expert teams via IIOT provides quick data analysis and solutions enabling successful startups. Technology platforms such as Schneider Electric's EcoStruxure can provide connectivity and flexibility under abnormal conditions and facilitate the safe recovery of O&G operations after a major weather event.

*“Schneider Electric’s innovations are founded on safety, reliability, efficiency, sustainability, and connectivity. Those are really the key values we want to provide to our customers. When we look at our digital strategy, the Internet of Things — combined with the convergence of IT and OT technologies — is really the foundation of this digital strategy.”*  
Cyril Perducat, Executive Vice President IoT & Digital Transformation  
Schneider Electric

## O&G can be Sustainable and Profitable

Sustainability has a measurable value. It can be quantified and improved under three metrics: economic, social, and environment. Companies are reorganizing and incorporating sustainability performance into their mission statements and daily operations. More important, these companies remain profitable. Sustainability grew out of the Responsible Care and environmental movements. Reducing carbon footprint through diversification into natural gas and renewable energy are some of the more popular and visible sustainable strategies that some major O&G companies are adopting. However, sustainability KPIs also encompass business and operational opportunities. Such KPIs are reducing costs, increasing equipment/unit availability, managing energy consumption, minimizing accidents and releases, increasing worker training, localization, and more.

Occupational health and safety is the highest priority for the O&G industry. It entails quality training and progressive equipment maintenance/monitoring policies. Handling hydrocarbons is a risky business. A single incident can wipe out all of the good will or sustainability credits earned by a company. Yet, risk can be reduced through innovative design practices. Advances in smart-field devices, high-fidelity models, control platforms/systems, IIOT, and emergence systems can be seamlessly integrated to operate O&G facilities in a safe manner and meet federal and state requirements. Sustainability is a broad compliance metric with many parts. More importantly, O&G companies can be greener and profitable.

### About the author

Constantine Lau is a Director of Oil & Gas Segment with Schneider Electric, and holds 20+ years of experience in Industrial Automation and Software. He is responsible for oil & gas segment business strategies and sales and marketing programs. Constantine graduated with dual engineering degrees from the University of Texas, and MBA from the University of Houston.

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